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MEMORANDUM

August 30, 1956

To : REA Field Engineers

From : R. W. Lynn, Chief
Telephone Engineering Division

Subject: Sample Maintenance Force
Requirement Study,,

The sample maintenance staffing study submitted herewith is for use as a guide in estimating the number of maintenance vehicles and personnel required in operations of borrowers' telephone systems.

Telephone company organizations are generally departmentalized for operational purposes. The operating functions with which REA is most concerned are Commercial, Accounting (general, revenue, and plant), Traffic, Engineering, and Plant. In large companies these are usually distinct and separate departments but in the average small company operation clear lines of authority and responsibility cannot be drawn. In small companies, typical of the average REA borrower, the same functions must be carried on but the responsibilities usually must be centered upon the manager who supervises all activities.

The method of determining the maintenance vehicle requirement illustrated in Telephone Operations Manual Section 1374, "Selecting and Maintaining Vehicles, Tools, and Other Work Equipment" applies equally well to determining maintenance personnel since in normal operations and maintenance work each workman requires one vehicle.

The use of TOM Section 1374 could well be applied by consulting engineers during the preparation of the ACD to obtain a more factual estimate of the vehicle requirements. Caution should be exercised in the application of this method, particularly in respect to the station and plant development of the project under study.

There are two stages of development that should be considered, (1) the stations and plant in the period immediately following cutover, and (2) the stations and plant at the 5 year point. It may be uneconomical to staff and equip initially for the estimated 5 year development, depending on the expected growth between cut-over and the 5 year development. Therefore, the first staffing study should be based on the initial or cutover development and for ACD purposes another study made on the estimated 5 year development for planning purposes.

Additional copies of the sample study for distribution to borrowers and consulting engineers can be obtained from TED upon request.

*D.B. Lee for
R. W. Lynn*

MAINTENANCE FORCE REQUIREMENT STUDY
(SAMPLE)

The approach used in preparing this study was as follows:

1. A system map showing the exchanges in approximate geographical location, the connecting roads, mileages and round-trip traveling time was prepared. See Exhibits E and F.
2. Plant data as shown in Exhibits A and C was accumulated from the ACD, ACS and the C.O.E. Contract.
3. The data on Exhibit A was then averaged to establish the average miles from headquarters, the average round-trip driving time and the average equipment components per office.
 - 3.1 The manufacturer's routine tests were then allotted time factors and the total estimated time (labor) to accomplish the routines was established on an average office basis with travel time added. See Exhibit B.

Note: The allotted time does not include time required to clear troubles encountered during the routine tests. Use of the round-trip travel time factor, however, provides some cushion as in actual operations such maintenance work should be "circle" routed to save driving time and vehicle expense.
 - 3.2 Routines 1 through 7 on Exhibit B are recommended by this manufacturer to be done weekly. Due to the long distances between exchanges, all C.O. maintenance activities were considered as monthly routines for the purpose of this study. It is recommended that consideration be given to further lengthening the intervals (to reduce maintenance costs and equipment disturbance) as the calling habits of the subscribers and operators conduct many of these tests daily. The intervals can be lengthened until it is determined from the trouble experience that a limit has been reached. (See Telephone Operations Manual Section 1238, "Trouble Reporting Records and Procedures"). Basic minimum or "insurance" routines such as lubrication, cleaning, and the functional testing of alarms, power and other common equipment should be regularly scheduled.
4. To determine the overall outside plant maintenance requirement the factors on Exhibit C were used in Column (1) of Exhibit D. (The method used was taken from Telephone Operations Manual Section 1374, "Selecting and Maintaining Vehicles, Tools, and Other Work Equipment". The daily outside plant maintenance hours required

amounted to approximately 19 or an apparent requirement of $2\frac{1}{2}$ maintenance men. As it would be uneconomical to maintain the entire system from one operating headquarters this portion of the study was made to determine how many maintenance areas might be required.

5. Areas as covered by columns (2) through (6) were then studied or tested. Although the estimated work loads in areas (2), (4) and (5) did not indicate full time loads the geographical locations appeared to offer a saving in driving time and vehicle expense. These maintenance areas are shown on Exhibit F.
6. Two maintenance areas were studied as shown in columns (3) and (6) of Exhibit D, and on Exhibit E. This plan although workable would require O.P. maintenance work at Exchange I to be done by the Manager.
7. In order to develop the plan shown on Exhibit F the central office routine maintenance was added to the O.P. maintenance with the result shown on Exhibit G. Although this plan requires training three men in C.O.E. maintenance, the advantages are as follows:
 - a. Less vehicle expense and traveling time on C.O.E. maintenance.
 - b. Faster C.O.E. trouble clearance at lower cost.
 - c. Flexibility for coverage during sickness and vacations.
 - d. A net saving in manpower.
 - e. Improved efficiency in maintenance performance due to knowledge of both outside and inside plant.
 - f. Centralized responsibility for all plant operations in each area..
8. Plant force requirements under the three area plan would appear to be three combination men supplemented by a two or three man construction crew. Under a two area plan the force requirements seem to be two combination men, one C.O.E. man, at least one installer and the construction crew.
9. To determine if the estimated maintenance staffing requirement is within the ability of the system to support financially the estimated maintenance man hours and vehicle miles should be converted into dollar costs and a comparison made with the estimated maintenance expense in the feasibility study.

9.2 The estimated costs should be based on:

- a. The estimated average loaded hourly rate of pay.
- b. The estimated average vehicle operating cost per mile.
- c. The estimated maintenance materials, supplies and other expense.

The above items converted to annual costs should approximate the projected cost of the maintenance staffing plan.

d. The study cost should be considerably less than the feasibility study maintenance cost since many maintenance costs included in the feasibility study are not included in this type of staffing study. Some costs included in the feasibility study but not in this staffing study sample are:

1. Annual reclearing and other major preventive maintenance programs.
2. Extraordinary maintenance such as storm damage repairs and resagging after ice loading.
3. Transmission power expense.
4. C.D.O. heating and air conditioning expense.

EXHIBIT A

CENTRAL OFFICE EQUIPMENT MAINTENANCE FACTORS
(Routine Maintenance)

| <u>Exchange</u> | <u>Miles from Hdqtrs.</u> | <u>R. T. Driving Time</u> | <u>C.O.E. Lines</u> | <u>Trunks</u> | <u>L.F.</u> | <u>First Sel.</u> | <u>Conn.</u> | <u>Inc. Trunk Sel.</u> |
|-----------------|---------------------------|---------------------------|---------------------|---------------|-------------|-------------------|--------------|------------------------|
| A | 50 | 2.50 | 33 | 2 | 6 | - | 6 | 2 |
| B | 12 | 0.75 | 32 | 2 | 6 | - | 6 | 2 |
| C | 96 | 5.00 | 20 | 3 | 5 | - | 5 | 3 |
| D | - | - | 167 | 3 | 16 | 16 | 16 | 3 |
| E | 55 | 2.75 | 60 | 9 | 7 | 7 | 7 | 9 |
| F | 66 | 3.50 | 108 | 4 | 10 | 10 | 10 | 4 |
| G | 50 | 2.50 | 50 | 3 | 7 | - | 7 | 3 |
| H | 25 | 1.25 | 35 | 2 | 7 | - | 7 | 2 |
| I | 30 | 1.50 | 40 | 3 | 6 | - | 6 | 3 |
| J | 30 | 1.50 | 90 | 3 | 9 | 9 | 9 | 3 |
| Total | 414 | 21.25 | 635 | 34 | 79 | 42 | 79 | 34 |
| Average | 41.4 | 2.125 | 63.5 | 3.4 | 7.9 | 4.2 | 7.9 | 3.4 |
| Use | 42 | 2.15 | 64 | 4 | 8 | 5 | 8 | 4 |

EXHIBIT B

MANUFACTURER'S RECOMMENDED ROUTINE INTERVALS

| <u>Item</u> | <u>Weekly *</u> | <u>Monthly</u> | <u>Quarterly</u> |
|------------------------------------|-----------------|----------------|------------------|
| Linefinders | x | | |
| Line Equipment | x | | |
| Selectors | x | | |
| Second Selectors | x | | |
| Connectors | x | | |
| Dial and Busy Tone | | x | |
| Ringing Current and Ring-Back Tone | | x | |
| Trunk Equipment, Operator Office | x | | |
| Trunk Equipment, Automatic Office | x | | |
| Inspection of Batteries | x | | |
| MDF | | | x |
| Charging Equipment | | x | |
| Miscellaneous Tests | | x | |
| General Cleaning and Inspection | | | x |

SUMMARY OF ROUTINE MINUTES PER AVERAGE EXCHANGE PER MONTH

| | <u>Estimated Minutes</u> |
|---|--------------------------|
| 1. Linefinder Tests | 16 |
| 2. Line Equipment Tests | 248 |
| 3. Selector Tests | 39 |
| 4. Connector Tests | 180 |
| 5. Dial and Busy Tone Tests | 10 |
| 6. Ringing Current and Ring Back Tests | 40 |
| 7. Trunk Tests | 20 |
| 8. Battery Checks | 36 |
| 9. MDF Checks and Cleaning | 5 |
| 10. Charging Equipment Tests | 6 |
| 11. Miscellaneous Tests | 30 |
| 12. General Cleaning and Inspection | 35 |
| | <u>665</u> |
| Average Routine Hours Per Exchange Per Mo. | 11 |
| Total Hours Per Month (10 Offices) | 110 |
| Travel Time (RT Basis) (10 Offices) Per Month | 21.5 |
| Total Manhour Requirement Per Month | 131.5 |
| Total Manhour Requirement Per Annum | 1578 |

* This C.O.E. Supplier recommends that approximately $\frac{1}{4}$ of the equipment be routined each week. In small offices this is not practical so these routines are done monthly in this estimate.

EXHIBIT C

OUTSIDE PLANT MAINTENANCE FACTORS

| <u>Exchange</u> | <u>Miles from Headquarters</u> | <u>R.T. Driving Time</u> | <u>Total Stations</u> | <u>Miles Pole Line</u> | <u>Average Trouble Trips Per Mo.</u> |
|-----------------|--|----------------------------------|---------------------------|--------------------------------|--|
| A | 50 | 2.50 | 137 | 139 | 7 |
| B | 12 | 0.75 | 121 | 174 | 6 |
| C | 96 | 5.00 | 98 | 160 | 5 |
| D | - | - | 317 | 123 | 16 |
| E | 55 | 2.75 | 182 | 172 | 9 |
| F | 66 | 3.50 | 222 | 225 | 11 |
| G | 50 | 2.50 | 206 | 178 | 10 |
| H | 25 | 1.25 | 131 | 181 | 7 |
| I | 30 | 1.50 | 148 | 133 | 8 |
| J | 30 | 1.50 | 202 | 164 | 10 |
| Total | 414 | 21.25 | 1764 | 1649 | 89 |

Average trouble trips per month based on 5 cases of trouble per 100 stations per month. The index of 5 cases is used in this study for estimating purposes only and is estimated to include all troubles affecting both inside and outside plant.

EXHIBIT D

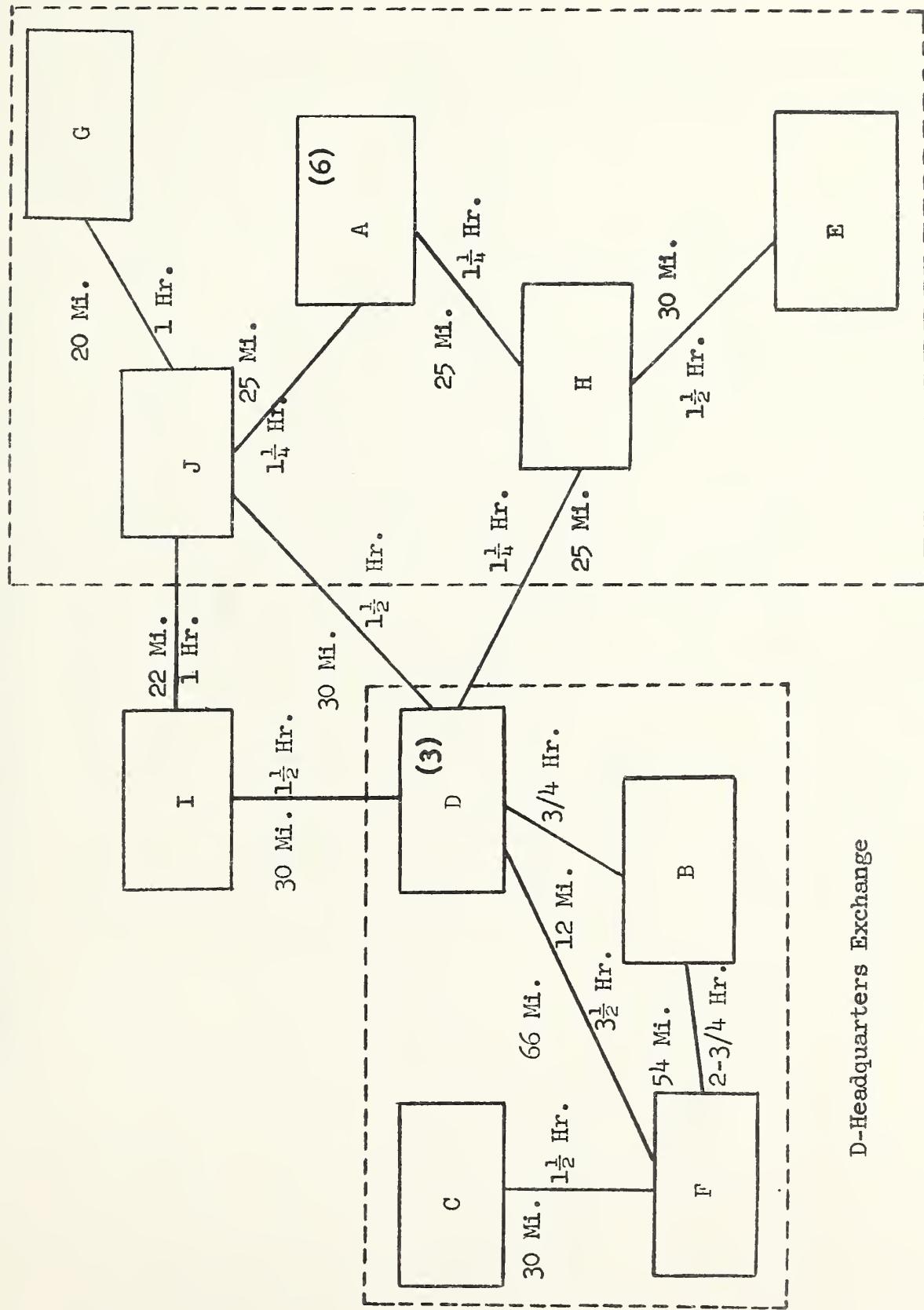
APPLICATION OF TOM SECTION 1374 FORMULA

| | (1) | (2) | (3) | (4) | (5) | (6) |
|--|-------|------|------|------|------|------|
| A. Miles of Pole Line | 1649 | 614 | 629 | 476 | 559 | 834 |
| B. Number of Stations | 1764 | 693 | 718 | 630 | 441 | 858 |
| E. Average Number of Trouble Cases Per 100 Subscribers Per Month | 5 | 5 | 5 | 5 | 5 | 5 |
| F. Misc. Preventive Maintenance Per Mile of Pole Line Per Year (Hours) | 1 | 1 | 1 | 1 | 1 | 1 |
| G. Misc. Preventive Maintenance Per Station Drop Per Year (Hours) | .25 | .25 | .25 | .25 | .25 | .25 |
| H. Driving Time Per Case of Trouble (Hours) | 2.25 | .8 | 1.79 | 1.05 | 1.1 | 1.5 |
| I. Labor Time Per Case of Trouble (Hours) | .5 | .5 | .5 | .5 | .5 | .5 |
| J. Work Days Per Year | 260 | 260 | 260 | 260 | 260 | 260 |
| K. Work Days Per Month | 21.7 | 21.7 | 21.7 | 21.7 | 21.7 | 21.7 |
| | | | | | | |
| (A X F) / J = Hours Daily | 6.34 | 2.36 | 2.46 | 1.83 | 2.15 | 3.21 |
| (B X G) / J = Hours Daily | 1.70 | .67 | .69 | .61 | .42 | .82 |
| (E X B / 100 X I) / K = Hours Daily | 2.03 | .80 | .82 | .73 | .50 | .99 |
| (E X B / 100 X H) / K = Hours Daily | 9.15 | 1.23 | 2.96 | 1.53 | 1.12 | 2.96 |
| Estimates Daily Work Load | | | | | | |
| Hours | 19.22 | 5.06 | 6.93 | 4.70 | 5.19 | 7.98 |

- (1) System Maintenance from Exchange "D"
- (2) I, J, A and G from J.
- (3) D, C, F and B from D.
- (4) D, H, and E from D.
- (5) F, C and B from F.
- (6) G, J, A, H and E from A.

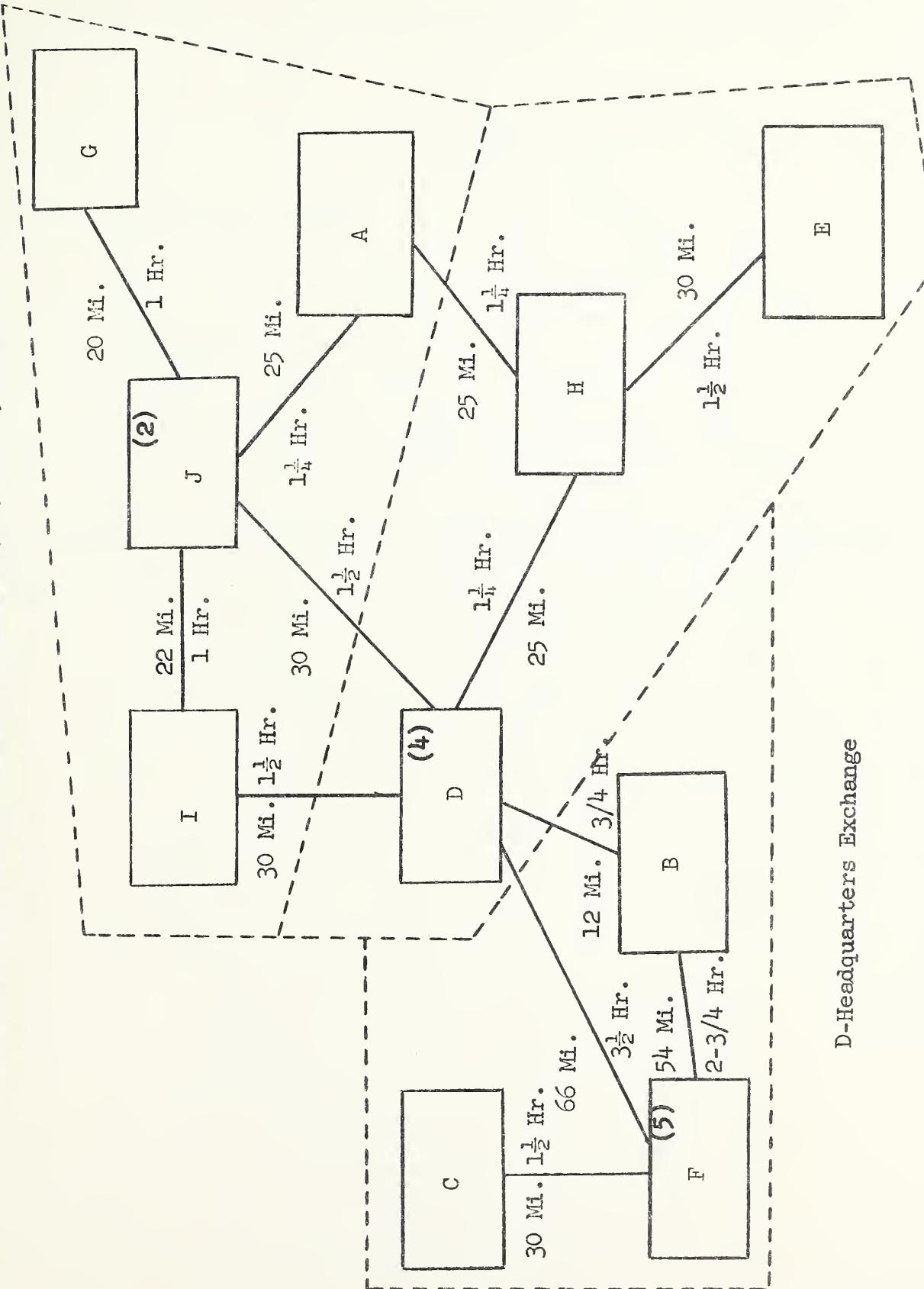
NOTE: Items C and D in Section 1374 formula not used in this study.

MAINTENANCE AREAS AS SHOWN IN COLUMNS 3 AND 6, EXHIBIT D



D-Headquarters Exchange

MAINTENANCE AREAS AS SHOWN IN COLUMNS 2, 4, AND 5, EXHIBIT D



D-Headquarters Exchange

EXHIBIT G

SUMMARY OF COMBINED C.O.E. AND O.P. MAINTENANCE HOURS
(Estimated)

| | Area (2) | Area (4) | Area (5) | System |
|--|-------------|-------------|-------------|-------------|
| O.P. maintenance hours per month | 110 | 102 | 113 | 316 |
| COE maintenance hours per month | <u>37</u> | <u>45</u> | <u>28</u> | <u>112</u> |
| Total | 147 | 147 | 141 | 428 |
| Total available (3 men x 173.5 hours): | | | 520.5 | |
| Balance available for station, work, etc.* | | Less | <u>428</u> | <u>91.5</u> |

*Additional time can be realized from efficient planning and routing of work.

No travel time was considered in the time allotted for C.O. maintenance figure above, as C.O. tests can be conducted on visits required because of other trouble.



